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Our coast…and beyond

Surfing and the perfect wave

The perfect wave is the stuff of legend amongst surfing communities – but what makes the perfect wave?

The cold waters around Britain's shores don't hold quite the allure of Oahu's warm Pacific Ocean, but surfing is a popular and increasingly diversified sport along our coastline. Different surfcraft – stand-up paddleboards, traditional longboards and shorter, three-fin 'thruster' boards – offer a variety of ways to immerse yourself in surfing's coastal pleasures. But all surfers rely on one thing: waves…

Most waves that arrive at our beaches originate miles away, out on the open sea. Wind blowing on the water's surface produces waves, with their size depending on the wind's strength, how long the wind blows and the area of sea over which it acts.

Eventually, these waves smooth out into rounded swells which can travel thousands of miles. On reaching shallower coastal waters, the seabed begins to affect them. The waves slow down causing them to bunch up and increase in height. Deceleration is greater near the seabed than at the water's surface so the tops of the waves start to overtake the bottoms, causing them to tip forward and break. Gently sloping seabeds result in waves that spill forward. Steeply sloping seabeds result in waves that break more dramatically.

Exactly how a wave breaks depends on the size of the incoming waves, offshore wind conditions and the slope of the seabed. The 'perfect wave' – where the top pitches well forward of the base, forming the classic barrel beloved of surfers – can be elusive. But Britain's surfers are pragmatic: it may be that the perfect wave is whichever one you're surfing…

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Learn more about surf culture at

www.open2.net/coast/watchlistenlearn.html

The Whin Sill

Formed when a thick layer of molten rock was squeezed into pre-existing layered rocks some 295 million years ago...

The Whin Sill forms a prominent rocky feature that stretches from the Farne Islands on the Northumbrian coast, across much of Northeast England and the Northern Pennines as far as Teesdale, where it is most famously exposed at High Force waterfall.

The Sill was formed when a thick layer of molten rock (magma) was squeezed or 'intruded' into pre-existing layered rocks some 295 million years ago during the Carboniferous Period. At the time when the Sill was intruded, the Earth's crust in this part of the country was being stretched and thinned due to movement of the Earth's tectonic plates. As the magma cooled down and solidified, it contracted and characteristic polygonal cooling cracks (joints) developed, similar to those seen in the rocks of the Giant's Causeway in Northern Ireland and at Fingal's Cave on Staffa, though these rocks are much younger in age.

The Whin Sill is composed of a dark-coloured, crystalline rock known as dolerite. Dolerite is an extremely hard rock that is more resistant to erosion than surrounding rocks, and thus forms steep rocky crags, cliffs and promontories.

In the past, these offered strategic advantage for defence, with much of Hadrian's Wall being built upon the Whin Sill. The Sill is well exposed at the Roman fort of Housesteads and can also be seen in the foundations of Bamburgh, Dunstanburgh and Lindisfarne Castles.

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Explore the rocks that make up these islands

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The Seahenge

A prehistoric landsurface emerged after winter storms scoured the beach at Holme, north Norfolk, in 1999...

The peat dune had eroded to reveal a Bronze Age circle of wooden posts with an extraordinary centrepiece. An ellipse of fifty-five oak posts surrounded a massive oak trunk, inverted so that its roots created a platform. Contemporary with Stonehenge, the site soon became known as 'Seahenge'. However, it is neither a henge nor did its creators intend it to be in the sea.

Archaeologists define henges by the presence of a ditch and bank, creating an enclosure, often with post-built structures inside it. But Seahenge was originally built on marshy, fresh-water ground, without the enclosure. Its location saved it from natural decay; firstly, because the waterlogged ground preserved the timbers in their post-holes and secondly, because peat growth sealed over the above-ground timber. The wood was able to be very closely dated to being felled in the spring of around 2049 BCE.

It is possible that the posts were carved – laser scans have revealed tool marks from very early bronze axes. Two posts, one split and one forked, were carefully positioned opposite each other. So good was the preservation that a rope made of twisted honeysuckle survived with the central oak trunk. Though no human remains were found, one interpretation of the stump is as a platform for exposing a dead body. Excarnation is the practice of allowing a body to decompose before gathering up the bones for burial, a practice used since prehistory and in cultures across the globe.

Seahenge is the best preserved timber circle in the UK. The timbers are on display in the Lynn Museum.

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Find out more about the mysterious seahenge

www.open2.net/coast/watchlistenlearn.html

Clydebank

The entanglements of industry and leisure!

The town of Clydebank has long been overshadowed by its close and somewhat larger neighbour, Glasgow. It has, however, a distinctive history and has long occupied an iconic position as a symbol of Clydeside's industrial past.

Firms that have played an important role in building Scotland's position as a powerhouse of the British Empire, including warship and armaments manufacturer William Beardmore, and shipbuilders like John Brown, were located in Clydebank. But the town's global reach was also signified by the presence of a large sewing machine factory operated by the American Singer Corporation, established in 1884/85. Singer's has long gone – though its legacy lingers on in many ways, not least in the shape of Singer railway station. Sewing machines represent both work and leisure activities. In some ways they capture the interplay of industry and leisure in Clydebank, though this is signalled much more powerfully by the three great Cunard cruise liners that were launched from Clydebank: the Queen Mary (1934), the Queen Elizabeth (1938) and, arguably, one of the most iconic of all liners, the Queen Elizabeth 2, or QE2. Built and launched in 1967 through the hard labour of working class 'bankies', the QE2 carried the rich and famous, at their leisure, across the world's seas. A story of hard labour for some – providing leisure for others!

More recently there has been a new (re-)weaving of industry and leisure in Clydebank, symbolised by the 150 foot tall Titan Crane. Dating from 1907 it was used in constructing the large ships built by John Brown & Co. The crane has today a new role as a leisure destination as Clydebank envisages its future as a post-industrial town.

Visit our website

Learn more about life in Clydebank at

www.open2.net/coast/watchlistenlearn.html

Crude oil and troubled waters

Cleaning up our modern mess...

Crude oil is a mixture of hydrocarbons – chemicals consisting mainly of carbon and hydrogen. Our industries use hydrocarbons for making fuels, e.g. petrol, butane and propane, manufacturing plastics and fabrics for clothes and upholstery, and for many other uses.

Massive oil spills – from wrecked oil tankers like the Exxon Valdez and the Amoco Cadiz, or the recent example of the exploded oil platform Deepwater Horizon in the Gulf of Mexico – have a huge impact on our coasts. Oil, whether crude or refined, is a toxic mix of chemicals and, where the spills are large, can contaminate the water and coastlines for hundreds of miles, polluting fisheries and killing marine life at all levels of the food web: plankton, fish, seabirds and mammals.

Although heroic attempts are made to clean up huge coastal oil spills, some of the chemicals used are actually damaging to wildlife and oil residues have persisted. A promising new approach is to use marine bacteria that feed naturally on oil.

The bacterium *Alcanivorax* breaks down pristane, an oily hydrocarbon secreted into seawater by marine zooplankton. *Alcanivorax* numbers increase to huge levels after an oil spill and they consume certain components of the oil. *Alcanivorax* secretes biosurfactants, which break up oil into emulsions and promote formation of bacterial biofilms on the surfaces of the oil droplets. Other bacteria break down oil pollution on mudflats – toxic components such as toluene, naphthalene and benzene are broken down by a specialist bacterium, *Cycloclasticus*.

Visit our website

How do you set about cleaning up an oil spill? Watch our video at

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Heligoland

Stopover for migrating birds...

The two islands of Heligoland sit in the North Sea about 44 miles north of the German coast. Düne, the smaller sandy island, is uninhabited. The larger island, Heligoland, includes a flat area at sea level, a high plateau and, since 1947, the Mittelland. Heligoland is populated – with people and lots of birds.

During World War II, Heligoland was a German Navy base and heavily bombed by the RAF. After the war, the Royal Navy used the islands as a bombing range. The largest explosion was the 'Big Bang' in 1947, which destroyed part of the island and created the Mittelland. In 1952 the islands were returned to Germany, cleared of ordnance and the inhabitants returned.

Heligoland is now a vital stopover for migrating birds heading for summer breeding grounds in continental Europe, and for those returning to their overwintering areas. Spring migrants include blackbirds, skylarks, chiffchaffs and woodcocks and later, robins, song thrushes, meadow pipits and many others. Elder, hawthorn and wild rose grow in patches on Heligoland, and in Spring, insects attracted by the leaves and blossom provide food for the birds. The Autumn migrants include both young and experienced birds that rest and feed on the energy-rich berry crops.

Heligoland is also a safe breeding site for the fulmars, oystercatchers, gannets, black-legged kittiwakes and guillemots that nest along the spectacular banded red sandstone cliffs, with views to Lange Anna, a tall sandstone stack, just out to sea.

Heligoland, with its strange wartime history, is an avian paradise with more than 400 species having been recorded on the islands.

Visit our website

Find out how Heligoland helps birds migrate at

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Soothing sound of the sea

Why does the coastal soundscape have such a calming effect on us?

Listening to an audio recording of waves lapping on a shore often proves a great aid to relaxation. But why does this coastal soundscape have such a calming effect on us?

One reason is that the sound of breaking waves has positive associations for most people, conjuring up memories of childhood trips to the beach or seaside holidays away from the stresses of everyday life. However, association is not the only factor. The sound also has certain intrinsic properties that contribute to its soothing nature.

The regularity with which the waves crash on to the seashore provides a sense of reassurance; after each wave break, you know that a few seconds later the next will follow. The sound never becomes monotonous though. Small differences in the time interval between successive waves, and in the loudness of individual wave breaks, provide an element of variation that keeps it interesting.

The composition of the sound that is produced each time a wave breaks also plays a role. The characteristic shhhhh noise of an incoming wave contains a wide range of frequencies and so tends to hide or 'mask' other sounds that are present in the local environment. The result is that sounds which might otherwise be irritating and intrusive – such as the roar of a car engine or the banging from a construction site – are at least partially concealed by the sound of the waves.

It is the combination of these different effects that causes the sound of waves gently breaking on a shore to have such relaxing and peaceful qualities.

Visit our website

Are sea sounds soothing? Listen and vote at

www.open2.net/coast/watchlistenlearn.html

Sea cliff climbing

Just hanging around…for a few million years…

Think of someone climbing. What is the picture in your head? Mountains? Men (it's always men, isn't it) roped together trudging across miles of snow? Flags on summits? For many, the real fun is not the relatively gentle slopes of the mountains, but the fierce 50m vertical and overhanging limestone cliffs of Dorset's Jurassic and the Welsh Pembrokeshire coastline.

Limestone is a sedimentary rock formed from uncountable layers of skeletal fragments of dead marine creatures such as corals and shellfish, but mostly the shell of a tiny organism called 'foraminifera'. Every now and then other, larger dead marine animals such as ammonites (similar to nautilus that live today) are preserved in the sediment. Pembrokeshire's limestone was formed about 350 million years ago, and Dorset's a couple of hundred million years later. At both times in the Earth's history, the climate was similar – what is now Western Europe was covered by warm, shallow tropical seas. Since then, geological forces have turned the sediment to stone, raised, fractured and eroded it into the incredible sheer rock faces we see today.

If the rock layers are parallel to the sea, climbing up is ascending time as well as height. Hand and footholds with only a couple of metres between them were formed millions of years apart. This is geological time and it blows your mind!

Now think of someone climbing – and picture this: blue seas with seals playing, holding onto warm golden limestone and looking down on seabirds and peregrines circling – with cool sea air in your lungs and the warm sun on your back, and only a few million years 'til you reach the summit.

Visit our website

Why do people climb cliffs? Listen to our expert quiz a climber at

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This broadly-focused course introduces you to university-level study in the arts across a range of subject areas, including history, art history, philosophy, classical studies, history of science, religious studies, music and English. It is structured around four themes, guiding you through some of the basic concerns of arts subjects: Reputations; Tradition and Dissent; Cultural Encounters; and Place and Leisure.

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